

Satellite-Derived Management Zones

Precision agriculture can be practiced at low cost.

Stennis Space Center, Mississippi

The term "satellite-derived management zones" (SAMZ) denotes agricultural management zones that are subdivisions of large fields and that are derived from images of the fields acquired by instruments aboard Earth-orbiting satellites during approximately the past 15 years. "SAMZ" also denotes the methodology and the software that implements the methodology for creating such zones. The SAMZ approach is one of several products of continuing efforts to realize a concept of precision agriculture, which involves optimal variations in seeding, in application of chemicals, and in irrigation, plus decisions to farm or not to farm certain portions of fields, all in an effort to maximize profitability in view of spatial and temporal variations in the growth and health of crops and in the chemical and physical conditions of soils.

As used here, "management zone" signifies, more precisely, a subdivision of a field within which the crop-production behavior is regarded as homogeneous. From the perspective of precision agriculture, management zones are the smallest subdivisions between which the seeding, application of chemicals, and other management parameters are to be varied.

In the SAMZ approach, the main sources of data are the archives of satellite imagery that have been collected over the years for diverse purposes. One of the main advantages afforded by the SAMZ approach is that the data in these archives can be reused for purposes of precision agriculture at low cost. *De facto*, these archives contain information on all sources of variability within a field, including weather, crop types, crop management, soil types, and water drainage patterns.

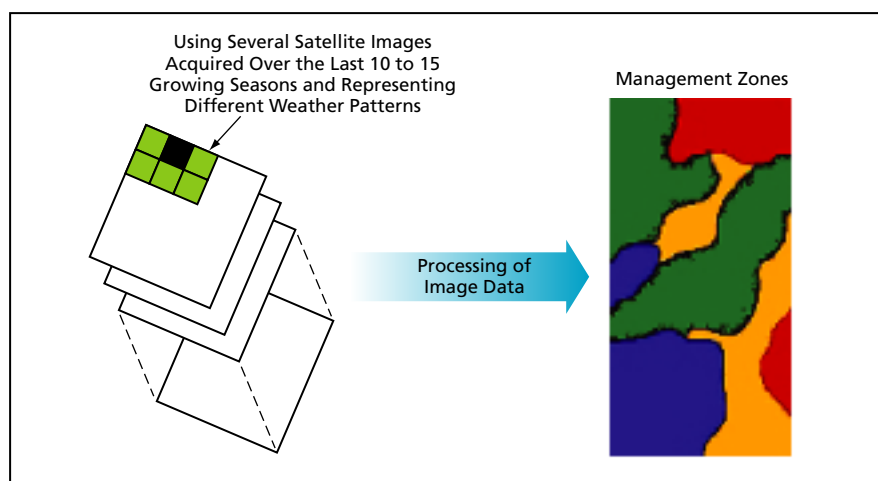
The SAMZ methodology involves the establishment of a Web-based interface based on an algorithm that generates management zones automatically and quickly from archival satellite image data in response to requests from farmers. A farmer can make a request by either uploading data describing a field boundary to the Web site or else drawing the boundary on a reference image. Hence, a farmer can start to engage in precision farming shortly after gaining access to the Web site, without need for incurring the high costs of conventional precision-agriculture data-collection practices that include collecting soil samples, mapping electrical conductivity of soil, and compiling multi-year crop-yield data.

Given the boundary of a field, a SAMZ server computes the zones within the field in a three-stage process. In the first stage, a vector-valued image of the field is constructed by assembling, from the archives, the equivalent of a stack of the available images of the field (see figure). In the second stage, the vector-valued image is analyzed by use of a wavelet transform that detects spatial variations considered significant for precision farming while suppressing small-scale heterogeneities that are regarded as insignificant. In the third stage, a segmentation algorithm assembles the zones from smaller regions that have been identified in the wavelet analysis.

This work was done by Damien Lepoutre and Laurent Layrol of GEOSYS, Inc., for Stennis Space Center.
SSC-00186

figure caption:
(2 columns)

Multiple Satellite Images of a Field are analyzed to identify zones for which different precision-agriculture treatments are needed.



REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p> <p>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>					
1. REPORT DATE (DD-MM-YYYY) 15-01-2004		2. REPORT TYPE		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE SAMZ: Satellite Derived Management Zones				5a. CONTRACT NUMBER NAS13-99034	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Associated Business Publication Inc.				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)				8. PERFORMING ORGANIZATION REPORT NUMBER NP-2004-01-00001-SSC	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Technology Development and Transfer Office				10. SPONSORING/MONITOR'S ACRONYM(S)	
				11. SPONSORING/MONITORING REPORT NUMBER	
12. DISTRIBUTION/AVAILABILITY STATEMENT Public Available STI per Form 1676					
13. SUPPLEMENTARY NOTES NASA Tech Brief					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19b. NAME OF RESPONSIBLE PERSON
a. REPORT U	b. ABSTRACT	c. THIS PAGE U			Technology Development and Transfer Office 19b. TELEPHONE NUMBER (Include area code) (228) 688-1929